artificial magnets vibrating within discs, or rings of the metals, included in the above table.

Professor Whewell in his Bridgewater Treatise, "on the power, wisdom, and goodness of God," (p. 113,) has remarked, "when we consider the vast service which magnetism is to man, by supplying him with the Mariners' Compass, many persons will require no other proof of this property being introduced into the frame of the world for a worthy purpose. Magnetism he adds has been discovered in modern times, to have so clear a connection with galvanism, that they may be regarded as different aspects of the same agents; all the phenomena we can produce with magnetism, we can produce with galvanim. That galvanism exists in the earth, we need no proof. Electricity which appears to differ from galvanism, the same manner in which a fluid in motion differs from fluid at rest, appears to be galvanism in equilibrium; and recently Mr. Fox* found by experiment, that metaliferous veins, as they lie in the earth, exercise a galvanic influence on each other. Something of this kind might have been expected from masses of metal in contact; if they differ in temperature, or, in other circumstances, are known to produce galvanic currents; hence we have undoubtedly streams of galvanic influence moving along the earth, but whether or not such causes as these produce the directive power of the magnetic needle, we cannot here pretend to decide; they can hardly fail to affect it."

The opinion here given is from *high authority*, and I cordially agree to it. The whole of the materials forming a ship are susceptible of magnetism by induction from the earth, the sea, and the atmosphere; the mechanical construction is such, that the whole fabric of the ship may be in a transient magnetic state, not only the iron, copper, lead, brass, and the other metals; but, also, the *wood* forming the hull, fastened or covered as it really is with these metals and their oxides. Need we then be surprised when we find the steering compasses deviating from the true direction of the magnetic meridian, or, vibrating several points on each side of the course, when a vessel rolls from side to side.

*(To be continued.)*

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ON BAR HARBOURS.—*By Mr. E. K. Calver, master H.M.S. Blazer.*

THE whole of the ports along the Eastern Coast of Great Britain, from Father Thames to John o'Groats, may be classed, with one or two exceptions, under the head of Bar Harbours. Some remain in the state determined by nature; others have undergone alteration by the erection of piers, sluices, breakwaters, &c., having for their object the removal of some existing evil. In one or two instances the effect produced has been favorable, in others the advantage is problematical; but, in the majority of cases, the intended remedy has proved worse than the disease, entailing, as a consequence, accumulated difficulties; a fact, suffi-

* Of Falmouth, in Cornwall.

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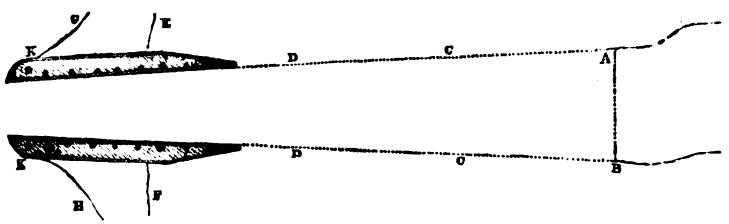
cient of itself to prove, that the projectors cannot possibly have been guided in their operations by any established law of cause and effect.

The following has suggested itself to me upon this interesting subject, though it will be seen that my sphere of action is very confined, as it only embraces, within its limits the cases of those rivers whose waters meet the ocean nearly at right angles.

### *Plan of Harbour Improvements.*

From a quarter of a mile above the junction of the river with the sea, gradually narrow its downward course, by embankment or otherwise, as most convenient, taking care that the divergence of the sides be not so great, as to cause the velocity of the outset at the entrance to exceed the rate of five miles per hour. The piers would be a prolongation of the river embankments, with the position of their extremes determined by the local conformation, &c.—(See following sketch.)




A to B, limits of operation.—C to D, embankments.—E to F, high water line.—G to H low water line.—K, capstans on Pier Head with warping posts.

For the application of this principle, let us take for example three rivers, whose breadth, and mean sectional depth at a quarter of a mile above their entrances is 500 feet and 9 feet respectively, but the rate of tide at half-ebb is severally one, two, and three miles per hour. Now, as the velocity of the outset must principally depend upon the conductor it has to pass through; and, allowing that the first effort of the contraction would scour the bottom between the pier-heads one-third lower from a mean level, the breadth of entrance proper in each case is arrived at by a simple proportion,—to attain the specified velocity of five knots, in the above instances it would be roughly 70, 140, and 200 feet.

Thus, in all cases, estimating the capacity of a river by its breadth, depth, and velocity, at a given distance from the sea, the width of entrance proportioned to it in accordance with the foregoing principle, may at once be arrived at.

### *Results to be expected.*

The advantages to be gained by this arrangement are numerous, though I shall briefly advert to the following, as among the most important:—

1. If the above plan, or any other having the same object in view, be found equal to the ordeal of a practical test; the mistakes which are daily committed in one section of marine engineering will be avoided,

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a ruinous and useless expense saved, and a depressing check be removed from the commercial spirit and enterprise of numerous localities.

2. Throughout our Eastern Coasts, piers of all descriptions, and in every variety of position are to be met with, thus, some are seen with circular, some with angular, and some with square terminations; some are straight, some are crooked, some curved, some are parallel, and others again retire from each other as they extend outwards, or, as they are termed, bell-mouthed; opening their jaws as it were for the reception of all the moveable matters in their vicinity. Piers with either circular, square, or angular ends have the effect of admitting a high and dangerous cross sea; which, on the flood, by disturbing the bed of the river, materially assists the internal sea deposit; but, with piers of the proposed description, a portion of the advancing wave would be cut off, this would advance upward by easy undulations, until it was finally overcome by friction, and the increased width of the channel.—(For the effect in each instance see figures 2 and 3.)

Fig. 2.

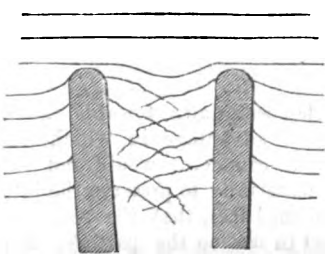
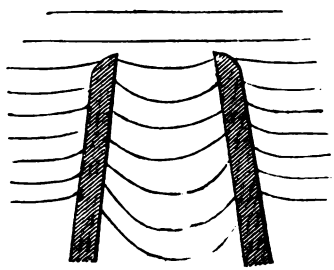


Fig. 3.



3. The ebb of the river, as it approached the pier heads, would gradually increase in velocity in proportion to the contraction, and the inclination of the embankments and piers, would have the effect of causing the body of the descending current to concentrate itself at a point considerably beyond the limits usually occupied by bars, outlying shoals, &c. At the same time it cannot be denied, that cross-going tides at the entrance, would partly neutralize the effect of the scourer; this, however, might be obviated by placing the ends of the piers well out, so that the deposit on their exterior sides caused by their own obstruction, might form a bight sufficiently extensive to cause the stream of the sea-tide to harmonize with the outgoing set of the river.—(For illustration see figure 4.)

4. According to the authority of Du-Buat and others, it appears that a velocity at the bottom of 36 inches per second, will sweep along angular substances of the size of an egg. If so, the rate of the proposed scourer, which is nearly double the amount, will hold in subjection all interruptions for a considerable distance outside the pier heads.

5. An accumulation of sea-deposit at the entrance, which, under existing circumstances, is generally the obstacle to be surmounted, would prove an important auxiliary in securing the success of the proposed

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place. From the force of the outset, the deposit must necessarily assume the form of a continuance of the piers, and would serve to convey the scourer to a greater distance, and into deeper water than would otherwise be the case.—(See figure 5).

Fig. 4.

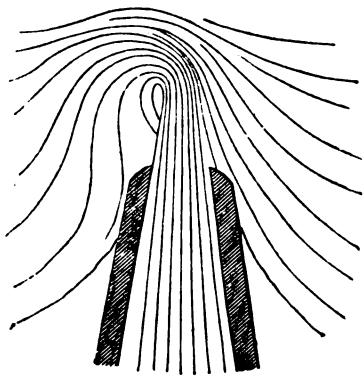
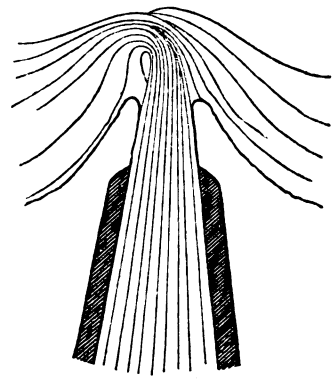


Fig. 5.



6. Quays or wharfs might be erected well down towards the mouth of the river. This would prove a great advantage in whichever way it may be considered; the demands of commerce would not only be facilitated, but it would also tend materially to preserve the integrity of the entrance, for it is a well established fact, that the action of the current under a ship's bottom is to set in motion the particles collected there; and it is clear, that if once set going, they would find their way out of the harbour's mouth; the agent which conveyed them in, is surely equal, with increased powers, to take them back again.

In conclusion, an important auxiliary to the foregoing principle, would be the establishment of a reservoir as near the source of the river as possible. The water from which (if the river was of moderate length) would find its way down to the sea about half ebb, and materially assist the scouring effort.

It will be perceived, that while advocating a trial of this particular principle of harbour making, I have assumed the inexpediency of a greater rate for the scouring power than five miles per hour; also, that it would be useless to take into consideration the minor points of local formation, &c., as they appear to be so completely outbalanced by this one great object—"the right constitution of the scouring power,"—this hypothesis might not hold good for a single instant, if tried by the test of experience; nevertheless, I offer it merely from never having seen a harbour constructed on the principle; and from the knowledge, that if the foregoing proposals be found possessed of the least particle of novelty, they cannot fail of provoking a very useful species of enquiry.

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